

The role of learning goals in the design of ILEs: Some issues to consider¹

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Abstract. Part of the motivation behind the evolution of learning environments is the idea of providing students with individualized instructional strategies that allow them to learn as much as possible. It has been suggested that the goals an individual holds create a framework or orientation from which they react and respond to events. There is a large evidence-based literature which supports the notion of mastery and performance approaches to learning and which identifies distinct behavioural patterns associated with each. However, it remains unclear how these orientations manifest themselves within the individual: an important question to address when applying goal theory to the development of a goal-sensitive learner model. This paper exposes some of these issues by describing two empirical studies. They approach the subject from different perspectives, one from the implementation of an affective computing system and the other a classroom-based study, have both encountered the same empirical and theoretical problems: the dispositional/situational aspect and the dimensionality of goal orientation.

Keywords. learner modelling, goal orientation, motivation

1. Introduction

The AIED community has achieved considerable success in the development of software that can adapt to learners' needs whether they are working as individuals or in groups. To some extent these software systems emulate aspects of the role of a skilled teacher and improve learners' educational experience. Much of the work has focused on issues such as the representation of domain knowledge, human-computer interaction, and some aspects of teaching strategies (see [1] for a review). Although it is largely recognized that the learning process is greatly affected by the emotional and motivational state of the individual learner, it is only relatively recently that these issues have also been addressed. We are making progress towards an increased understanding of how an individual's cognitive and emotional states interact with each other and how this can help us to develop better intelligent learning environments (ILEs); systems that can recognize, acknowledge, and respond to emotional states by using, for instance, motivational tutorial tactics to promote learner affective states that are conducive to learning (e.g. [2]). In this

¹This research was partially supported by Mexico's National Council of Science and Technology and the UK's Engineering and Physical Science Research Council

paper we explore the learner's goal orientation and the impact this can have upon their learning.

We report two studies with a common approach to the evaluation of a learner's goal orientation, but a different motivation for wishing to make this assessment. The first study is concerned with developing software that can adapt to a learner's goal orientation, and the second explores the ways in which goal orientation impacts upon learner engagement with collaborative learning using software. This work is important to the AIED community: as we develop increasingly sophisticated approaches to software scaffolding that address metacognitive and help-seeking behaviour (e.g. [3]), we also need to understand the influence of goal orientation. Similarly, work that aims to develop computer supported collaborative learning solutions will be informed by a greater understanding of the extent to which goal orientation interacts with a learner's collaborative style. At the heart of this is a need for us to understand more about what goal orientation is.

Achievement goal theory argues that the goals an individual pursues in an achievement context create a framework, or orientation, from which that individual interprets and reacts to subsequent events. These goals mediate internal processes and external actions and are important contributors to the self-regulatory processes involved in learning [4]. Examining the achievement goals a learner holds, therefore, informs our understanding of how individuals behave in learning contexts; vital information in the design of adaptive learning environments.

Two distinct orientations or patterns of achievement goals have been identified. An individual with a *performance goal orientation* interprets success as a reflection of their ability, they strive to receive positive judgments of their competence and avoid negative ones. In other words, they regard learning as a vehicle to public recognition rather than as a goal in itself. Somebody with a *mastery goal orientation*, in contrast, regards success as developing new skills, understanding content, and making individual progress: that is, learning is the goal itself.

These different learning goal orientations are associated with distinct behavioural patterns and learning strategies [4,5]. If a system can respond to the motivational orientation of individual learners, something expected of a human teacher, a more adaptive approach to learning may be encouraged, either by emphasizing a mastery approach by the tutor or by responding to the individual's own learning goal orientation. Further research needs to investigate the extent to which goals impact on the way in which learners interact with a computer system. We believe that having a better understanding of how individuals feel and act when interacting with a system could help with the ultimate goal of intelligent tutoring systems (ITSs) in customizing instruction for different student populations by, for instance, individualizing the presentation and assessment of the content. Exploring achievement goals may therefore be an important aspect of designing and constructing a learner model. However, we argue that if it is to be applicable in everyday educational contexts further empirical investigation into the nature of learning goals is needed. The following two empirical studies have highlighted the questions which remain unanswered within achievement goal theory and which, we argue, contribute to it being problematic, in its current form, when applied to specific educational contexts.

2. Individual differences in goal orientation

We describe two studies that address the individual differences that exist when different learners engage in the same task and the differential learning consequences of these differences. Both studies frame their investigation within an achievement goal perspective. Finally, they both use a standard method of measuring learning goals; the Patterns of Adaptive Learning Scales questionnaire (PALS) [6].

The first study looked at the way children interacted with two versions of an interactive learning environment that tried to emphasize a particular goal orientation by means of the feedback provided and some elements of the interface. The second study explored how goal orientations influence the way in which learners engaged in a computer-mediated collaborative task.

2.1. Study 1: Motivation and the influence of achievement goals

In recent years, modelling the student's motivational state has become a more recognised aspect in the design of interactive learning environments [7]. The current study investigated the role of students' goal orientations when interacting with educational software, in order to inform the design of more effective affective computing. The aim was to investigate, within a computer context, whether 1) emphasizing a particular goal orientation has an effect on individuals' performance; 2) a specific goal-oriented context works better for individuals according to their ability level; 3) an individual's goal orientation is overridden when they interact with a context that emphasizes a different goal orientation.

2.1.1. Method

A sample of 33 students, 9 to 11 years old, were asked to complete 1) a pre-test to assess their knowledge of the domain of ecology and 2) the PALS questionnaire [6] to assess their goal orientation. Then, they were allocated randomly to interact either with a mastery-oriented, performance-oriented or original version of the Ecolab (described below). A post-test was completed after the interaction with the system and a delayed post-test three weeks later.

2.1.2. The three different versions of Ecolab

The Ecolab II [8] is a system which was implemented within a Vygotskian design framework for the domain of ecology concepts such as food chains and food webs. The Ecolab plays the role of a more able partner that models how well the learner is doing and provides assistance accordingly. The Ecolab II was modified in order to implement two versions, one emphasizing a mastery goal orientation and the other a performance goal orientation [9]. Each version chooses an appropriate feedback strategy aimed to keep the student in a positive motivational state. For instance, if a student's persistence is low, her confidence is high and she has made an error, then the feedback provided promotes more persistence. In this case, the mastery system's motivational feedback might be "Learning how to do it requires another attempt", whereas the performance feedback might say "If you want to be the best, try again", in order to emphasize comparative judgements with other students. Along with the differences in motivational feedback, help is provided on demand in the mastery version, whereas the performance version offers help every time an incorrect action is performed (see [9]). In addition, elements of the interface are used to emphasize a particular goal orientation.

2.1.3. Results

When looking at cognitive strategies, e.g. help-seeking behaviour, or motivational strategies, e.g. expenditure of effort, no significant correlation with students' goal orientation or system used was found. When help was offered on demand, the students rarely made use of it, whereas in the case of automatic help the students did not have the choice of whether to accept it or not. In the light of these results, another study has been carried out, using adjusted versions of the software and increasing the interaction time with them, the analysis of the data is currently taking place. An important aim is to get empirical evidence to support or refute the claims that have been raised in achievement goal theory, particularly when considering a human-computer context.

2.2. Study 2: Collaborative learning and the influence of achievement goals

The results of Study 1 highlight some of the difficulties of applying achievement goal theory to the design of a single-user task. However, in school learning contexts, particularly during computer-mediated work, students will often work collaboratively. This raises additional questions about how to apply achievement goal theory to the design of a collaborative system, in which the goal orientation of not one but two learners will be important. In addressing this question, Study 2 explored the extent to which a child's goal orientation influences the way in which they interact and collaborate with a peer. This was a classroom-based study, in which pairs of students interacted with a non-intelligent system, but many of the same problems encountered in Study 1 became evident. This study, therefore, raises similar questions about our current understanding of learning goals, how they manifest themselves within the learner and how they are best applied to ILEs.

2.2.1. Method

A sample of 22 students aged 7 to 9 were observed participating in three collaborative sessions using a piece of software designed to guide their exploration of language awareness in joking riddles [10]. The aim of the study was to assess the nature of each student's participation in the interaction and relate this to their learning goal orientation. Collaboration was measured by analysing the language used by individual students. A coding scheme was designed for this purpose which consisted of 18 subcategories each falling into one of the following 5 language categories: Metacognitive comments, positive regulatory comments, negative regulatory comments, task specific comments and other comments. Learning goals were measured with the use of a teacher-rated questionnaire adapted from the PALS [6].

2.2.2. Results

Results indicate that learning goal orientation was significantly related to specific categories of language falling within the positive regulatory category. For example, the more mastery-oriented a child was, the more they engaged in constructive disagreements with their partner, $r = 0.62, p < 0.01$. On the other hand the more performance-oriented a child was, the less they engaged in this type of interaction, $r = -.413, p = 0.06$, a statistic approaching significance. A socio-constructivist approach to learning argues that in order for development to occur in the course of social interaction, students need to be

able to resolve initially different perspectives in order to reach a new and joint understanding of the task at hand [11]. The results of this study indicate that the performance-oriented child may find this aspect of collaboration more difficult as they are less likely to vocalise disagreements than their mastery-oriented peers.

These results suggest a relationship between collaborative style and learning goal orientation, an interaction with warrants further investigation if a system is to scaffold collaborative interaction between users in relation to their learning goal orientation. However, these results need careful consideration in relation to the method of measuring learning goals. A child's orientation was decided by a median split, but in fact, most scores fell close to the neutral point and few could be classified as an extreme of either orientation. This suggests that learning goal orientation may not be as straightforward as the literature implies and that a given individual may be oriented towards both mastery and performance goals. Both studies found this problem with the PALS questionnaire, which raises methodological and theoretical issues about the way in which learning goal orientations are understood and consequently measured.

3. Current limitations of achievement goal theory

3.1. Dimensionality

There is no clear consensus within the literature about how to understand the constructs underlying mastery and performance goal orientations. For example, many authors understand the mastery/performance distinction as the end points on a single bipolar dimension, with a strong mastery goal orientation at one end and a strong performance goal orientation at the other [5,4]. Within this framework an individual can either be mastery-oriented or performance-oriented to a greater or lesser degree but not both. The other way learning goals have been understood are as separate dimensions that are neither mutually exclusive nor contradictory, but independent (e.g. [12,13]). The general perception from goal theory research is that performance and mastery goal orientations are part of a single dimension. While this is a theoretical issue, it has important consequences for studying achievement goals in real world learning contexts, an issue highlighted by difficulties we encountered in measuring learning goal orientations in the current two studies.

The PALS questionnaire [6] adopts an independent dimensions approach to the measurement of learning goals. Both studies found a similar effect using this scale, in that it was difficult, if not impossible, to classify individuals with orientations of mastery, performance-approach or performance-avoidant, as many scored high (or low) on all 3 dimensions. This suggests that it is not only possible to hold both mastery and performance approach goals simultaneously but also performance avoidance goals. Midgley *et. al.* (2000) suggest the PALS questionnaire should be used more as an indication of an individual's achievement goal tendency and not as a means of classification into one orientation or another [6]. However, in our studies there only ever appeared very slight tendencies one way or the other, with most students being rated similarly on all three goal dimensions. These results question an independent dimension approach, because if measuring goals in this way can mean an individual can hold different goals to the same extent at the same time, it does not account for the different cognitive, affective and behavioural patterns observed and associated with different orientations.

An alternative method is a forced choice measure adopted by Dweck which involves giving participants the choice between one of two tasks [14]. Each of the tasks appeals either to a mastery orientation, emphasising a learning dimension, or a performance orientation, emphasising the potential for demonstrating existing knowledge. The choice made by the participant is then taken as the measure of their goal orientation. This approach adopts a dichotomous view of learning goals in that the individual can not choose both tasks and, therefore, can only be classified as either performance- or mastery- oriented. While this solves the problems presented using the PALS questionnaire, i.e. one cannot be both orientations, it raises another, in that it does not assess the strength of an individual's goal orientation. It therefore forces participants into making the distinction, thereby pigeonholing them into one or other category without any opportunity to indicate the strength of their behavioural tendency. It also relies on making an inference from the behaviour displayed to the reason behind or motivation for that behaviour.

Neither of these approaches to the measurement of learning goal orientation takes into account the specific context in which a goal may be salient. The PALS questionnaire asks very broad questions about an individual's attitude toward learning, for example, "One of my goals is to show others that I'm good at my classwork." [6] (p.12). No reference is made to the specific type of classwork, the particular domain, or to whom the "others" refers, be they classmates, teachers or parents. In this sense the authors have attempted to keep each item on the questionnaire as context-free as possible. A similar attitude to context appears too in Dweck's task choice measure where she asks the participant whether they prefer "problems that aren't too hard" or "problems that I'm pretty good at" [14](p. 185).

Theorists have, therefore, deliberately attempted to decontextualise the way in which learning goal orientations are measured. However, it may be the very issue of context and how it influences the adoption of different learning goals that is fundamental to understanding the impact of learning goals on a learner's achievement behaviour. We argue this needs to be addressed if achievement goal theory is to have any practical use in the design and implementation of educational environments, computer supported or otherwise.

3.2. Dispositional vs. situational approach

The influence of context on learning goal orientation is related to the question of whether goal orientations can be considered as personality traits, stable across time and contexts, or as situational states which vary according to specific contexts. Goals are considered to be situational variables, when they are manipulated for the purposes of a given study (e.g. by means of task instructions [4], type of feedback [15], or retesting opportunities and criterion-referenced grading [16]). Studies which have attempted to do this have created mastery or performance contexts for short-term empirical measurements and have not followed up the extent to which goals have remained altered after experimental manipulation. The alternative perspective views goal orientation as stable and measurable dispositional traits. Studies adopting this perspective tend to measure the individual's orientation and how this influences their response patterns across situations (e.g. [12,17]).

Theorists adopt either a situational state or dispositional trait approach depending on their emphasis i.e. either developing classroom styles that are specifically designed to foster mastery goals [5,16] or understanding more about multiple goal perspectives

before concluding that a mastery goal perspective is more adaptive [18]. Few have addressed the issue directly. However, it is our belief that this is another essential element in the understanding of learning goals and how they manifest themselves which needs more empirical evidence.

The resolution of this argument has implications for the way a system might use motivational dimensions to enhance a learning experience. For example, if goals are primarily dependent on context, regardless of an individual's goal orientation, then a context can be created to encourage the adoption of appropriate goals for that context. Alternatively, if the individual's orientation is stronger than environmental cues, learning activities can be designed to appeal to and match particular orientations. Taking this into account and considering the use of computer learning environments, a sensible approach to investigate how dispositional and situational variables interact within the individual is to design contexts that encourage the adoption of particular goals whilst also measuring the individual's dispositional traits. If a particular goal-oriented context proves to be "enough" to achieve a general improvement in learning, then it would be advisable to design learning activities according to that goal orientation. However, if more learning gains are found when individuals are exposed to goal-oriented contexts that match their goal orientation, then more attention needs to be focused on the simultaneous effects of both aspects: dispositional and situational.

4. Conclusions

The main goal in ITSs is to design systems that individualise the educational experience of students according to their level of knowledge and skill. Recent research suggests that their emotional state should also be considered when deciding the strategy to follow after an action has been taken.

This paper has focused on the importance of students' goal orientation. Achievement goal theory argues that different patterns of achievement behaviour become evident depending on the type of motivational orientation a learner adopts. However, we argue that further empirical investigation is needed, particularly as results from classroom-based studies question the way in which learning goal orientations and their impact are currently understood.

We argue particularly for the inclusion of context, such as a collaborative vs. an individual learning environment, to be considered an important variable in the understanding of learning goal orientations. This will have implications for the way in which learning goals are measured and defined. Current conflicting perspectives make it very difficult to measure learning goals and consequently their impact on students' behaviour in different contexts, which makes the application of achievement goal theory particularly difficult. We believe that exploring the role of context explicitly may go some way to resolving some of the current limitations. Future work will aim to identify ways of implementing a context-specific goal perspective in the design of ILEs.

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